## REMARKS

Reexamination and reconsideration of the rejections are hereby requested.

The presented claims are directed to methods and apparatus for controlling movement in a dynamic system through various techniques not disclosed in the prior art. The techniques include various modeling steps and/or shaping steps, with a goal of reducing unwanted mechanical and/or acoustic vibrations. In particular, independent claims 1 and 33 are directed to a method and apparatus for controlling movement of a dynamic system which can be expressed in terms of both rigid and flexible modes, including steps of generating and processing a rigid body input to produce a processed input which compensates for vibrations in the flexible mode of the system. Independent claims 23 and 55 are directed to a method and apparatus for determining a response of the dynamic system in terms of a modal analysis in a plural mode model of the system, and calculating approximations of values relating to plural switch times based on estimated values using an expression for the contribution of each of the plural modes to a final location of the system. Independent claims 31 and 62 are directed to a method and apparatus for determining whether a system input will excite a system to greater than a predetermined level of vibrations, and modifying an input that does so as to reduce the level of vibrations in the system to less than the predetermined level of vibrations. Independent claim 64 is directed to a method of generating a model defining system position in terms of both time and a system input and constraining the system in accordance with one or more constraints relating to unwanted vibrations. Independent claim 68 is directed to a method of shaping a current command using a unity magnitude shaper to drive a current controller into saturation, and supplying voltage as a physical limiting parameter to the system from the power supply via the current controller in saturation. Independent claims 69 and 77 are directed to a method and apparatus for controlling a dynamic system or data storage device system having one or more

feed forward inputs, where one of the feed forward inputs corresponds to a fundamental limiting parameter of the system, by altering the feed forward input so as to reduce unwanted dynamics of the system. Independent claim 84 is directed to a method of shaping an input comprising digital data sampled at a predetermined frequency, by identifying system vibrations corresponding to a sine wave having two sample points per period that occur at the Nyquist frequency for the system, and applying a three-pulse shaper to the input. Independent claim 85 is directed to a method of generating an input to a computer-controlled dynamic system, by determining the frequency of vibrations to be suppressed, and if the frequency is at or below a servo rate for the dynamic system, determining a servo output based on servo calculations and outputting the servo output as the input to the dynamic system, but if the frequency is above the servo rate for the dynamic system, shaping a trajectory and outputting the shaped trajectory as the input to the dynamic system. Independent claim 86 is directed to a method of generating an input by determining a servo output based on servo calculations, shaping a trajectory value for the feed forward input, and adding the servo output stored in memory to the shaped trajectory value so as to generate a feed forward input. Independent claim 87 is directed to a method of shaping an input command to saturation, inputting the saturated command until a first predetermined condition is detected, shaping a transition of the input command during deceleration from saturation until a second predetermined condition occurs, and following a preset trajectory until the dynamic system comes to within a predetermined proximity of its final state. Independent claims 89, 95 and 98 are directed to methods of generating commands for a dynamic system in a first parameter which maintain a limit in a second parameter, where the second parameter comprises a fundamental limiting parameter of the dynamic system, by determining a response of the second parameter in the dynamic system to a unit command in the first parameter, and generating the command in the second parameter based on the response

determined in the determining step. Independent claim 97 is directed to a method of identifying transitions of an input command to the dynamic system, and shaping transitions of the input command so as to result in a system response to the input command with reduced vibrations. Finally, independent claim 102 is directed to a method of linearly rescaling a vibration-limiting input to a dynamic system.

As described above, the pending claims are directed broadly to method and apparatus for controlling a dynamic system. Applicant disagrees that a new title is required. It is submitted that the existing title is commensurate in scope with the pending claims. Reconsideration is requested.

Claims 14, 15, 46 and 47 have been objected to as being indefinite for failing to particularly point out and distinctly claiming the subject matter which applicant regards as the invention. Claim 14 depends from independent claim 1 and recites that the rigid body input comprises a symmetric input. Claim 15 depends from claim 1 and recites that the processing step processes the rigid body input in accordance with a symmetric constraint that varies as a function of at least one of time and position of a component of the dynamic system. Similarly, claims 46 and 47 are corresponding apparatus recitations of this aspect of the invention. It is submitted that these claims are distinct and supported in the specification. For example, in the specification at page 46, line 17, there is stated that "Additionally, symmetric and multi-step (i.e., Posicast) inputs can be used to generate a good move." This section of the specification goes on to say that additional constraints may also be added to the system in order to control vibrations and states specifically that the constraints can be symmetric and can be a function of time or position. Reconsideration is requested.

The examiner has objected to claims 33, 55, 62 and 77-83 because they include the phrase "computer executable process steps." The examiner is correct that these claims are

apparatus claims. Specifically, claim 33 sets forth the following structural elements: a memory and a processor. The memory structural element is characterized as storing computer-executable process steps. It is submitted that this claim is definite in that it is a correct characterization of the memory that it stores computer-executable process steps. It is submitted that there would be no confusion as to whether or not these claims are directed to an apparatus.

Claim 88 has been objected to because of the nomenclature "PV" table. It is submitted that this nomenclature is well known to those of ordinary skill in the art. For example, the examiner's attention is directed to the specification at page 6, first line that states that various position-velocity table formulations are provided for reducing system vibrations. We note that the examiner refers to the Singhose, et al. prior art patent as teaching a preset trajectory defined by a PV table. It is submitted that this nomenclature is known to those of ordinary skill in this art. Reconsideration is requested.

Claims 1-20, 22-27, 29-63, 65, 68-75, 84-89, 91-98 and 100-102 have been rejected under 35 U.S.C. § 102(e) as being anticipated by Singhose, et al., U.S. Patent No. 5,638,267. The examiner has pointed to Singhose at columns 27 and 28. Singhose teaches representing a system with a model having a single flexible mode and a rigid body mode. Constraint equations are solved for movement of the center of mass to limit the amount of residual vibration. Singhose also teaches a final constraint that ensures that the solution is time optimal.

In contrast to the Singhose approach, in one aspect, the present invention determines an input to the system that will result in limited (or reduced) vibrations and uses that input as a feed forward trajectory for the system. In one approach, the problem with generating an input is separated into a rigid mode problem and a flexible mode problem. Specifically, terms associated with the rigid mode of the system are determined from partial fraction expansion equations in terms associated with oscillating or flexible modes of the system and are determined based on a

system analysis. The rigid body terms are solved for an input which drives the system so as to satisfy its rigid body constraints. This input has been shaped to compensate for flexible modes of the system.

As discussed on page 5 of the present specification beginning at line 22, the approach according to the invention reduces the computational difficulty of obtaining a solution relative to the optimization approach of Singhose while at the same time still providing an adequate reduction in levels of vibrations in relevant modes of the system. Thus, independent claim 1 and those claims that depend ultimately from claim 1 are free of Singhose's teaching.

With respect to independent claim 23, there are several differences between what is claimed and the teachings of Singhose. For example, the examiner asserts that Singhose teaches estimating values relating to the plural switch times and cites Singhose column 51, lines 11-22 to support that position. It is submitted that this section deals with a time optimal trajectory and does not estimate values related to plural switch times. Similarly, the section of Singhose cited by the examiner does not teach or suggest the limitation of calculating approximations of the values relating to the plural switch times based on the estimated values using the expression for the contribution of each of the plural modes and the model analysis in the model of the dynamics. Reconsideration is requested.

Independent claim 31 is directed to a method of reducing unwanted vibrations in a dynamic system. It includes the steps of determining whether greater than a predetermined level of vibrations will be excited by a system input and modifying the input of the dynamic system in a case that greater than the predetermined level of vibrations will be excited and the input to the dynamic system is modified so as to reduce the level of vibrations in the system to less than the predetermined level of vibrations. These aspects are not taught in Singhose.

Apparatus claims 55-61 are patentable for the same reasons as discussed above with respect to earlier method claims. It is submitted that the remaining independent claims are also free of Singhose's teaching, and it is requested that the 35 U.S.C. § 102 rejection be reconsidered and removed.

Claims 28, 64, 67, 76-83, 90 and 91 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Singhose in view of Wang, et al., U.S. Patent No. 6,148,240. It is noted that claim 28 is a dependent claim and is allowable for the reasons set forth with respect to its base claim 23. As to claim 64, the examiner relies on Wang, et al. for teaching a bang-bang apparatus. It is submitted that this teaching of Wang does not meet claim 64. It is noted that claim 67 depends from claim 64 and is therefore allowable. It is further submitted that the remaining claims are not obvious in view of Singhose and Wang.

It is noted that claims 21 and 66 are held to include allowable subject matter and applicant reserves the right to rewrite these claims into independent form at a later stage if necessary.

Respectfully submitted,
CHOATE, HALL & STEWART

Sam Pasternack
Registration No. 29,576

Patent Group
CHOATE, HALL & STEWART
Exchange Place
53 State Street
Boston, MA 02109-2804
Tel: (617) 248-5000
Fax: (617) 248-4000

Date: December 21, 2004